# RESET CONTROL IN MODULAR NETWORK COMPUTERS

## FIELD OF THE INVENTION

This invention relates generally to networked computer systems. More particularly,

5    this invention relates to control signals communicated between a host computer and client

computers on a networked computer system.


## BACKGROUND OF THE INVENTION

10    Many computer networks use what is known as client/server system in which a

network host computer provides a number of centralized hardware and software resources

for a number of client computers in the network. Traditional network topologies organize the

network server and clients as separate and individually controlled units. Each client is

generally a stand-alone PC, and as such can operate independently of the network host.

15    This includes such control functions as power on/off and reset of adapter or peripheral

cards contained in the PC. Likewise the server is generally a fully independent computer,

and is capable of independent processing, power cycling and reset or re-initialization.

One disadvantage with such networked systems is that individual client

computers in the network cannot be reset by an explicit command from the host. Therefore

20    in the event that a particular application running on a client machine and in communication

with other network participants disrupts the systems, the host has no means by which the

disrupting application can be halted. In severe situations, it may be required to sever the

connection and cycle the power to all machines involved.

More recently, modular networks have become available, in which a small local

25    area network is comprised of a host computer with a plurality of modular single board

computers (MSBC) electrically connected to the host. The MSBC's are generally

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implemented as components connected on a printed circuit board, in the format of a

replaceable feature card for a host system, and plugged into one of a set of bussed

connectors forming the backplane of the host computer. The MSBC may be rendered, for

example, on a 12" x 5" card, with the bus connector for the host backplane at one end, and

5 I/O ports installed in a bracket at the far end. The cards comprise the client computer,

which then communicates with a remote client terminal by cable connection to the I/O ports

of the MSBC. The Host most often functions as a server or peer client.

In analogy to traditional networks, the individual host computers of a

modular network may also be interconnected into a network cluster.

10 Modular networks do not suffer from the same disadvantage described above for

traditional networks, in which the host is unable to halt a client application. For modular

networks, applications running on client PC cards can indeed be halted by resetting or

reinitializing (Cntl + Alt + Del) the host computer. However, because of the configuration of

the modular network, all client MSBC's will be reset or powered down as a result of a host

15 reset, as the clients PC cards are plugged directly into the host bus. This obviates many of

the advantages of having independent computers attached via the network. In fact,

software applications, operating systems, network management tools and user training

have become accustomed to this characteristic, and it has become a de facto standard and

required for compatibility.

20 While a host system power failure may be made unlikely by application of

redundant or uninterruptible power supplies, reset conditions may occur spontaneously. For

example, as a result of processing activity among the plurality of client computers,

conflicting commands may disrupt the timing or logic flow of the host computer, resulting in

a "hung" state. Only a reset affecting all on-board cards may clear the hung condition of the host.

A number of patents recognize the need for partial control of otherwise independent client computers. For example, in Truong et al., U.S. Pat. No. 6,160,873, issued December 12, 2000, a system and method are described for allowing remote initialization, operation, and monitoring of a general-purpose computer and its power supply. This functionality is achieved through bi-directional control of the computer by a remote user via telephone. The telephone signals are received and converted to keyboard control signals, allowing for operations executable by the computer to be remotely generated. This approach is impractical, however, for modular networks where the host and the clients are essentially collocated.

Another approach can be found in Shah, et al., U.S. Pat. No. 6,141,711, issued October 31, 2000. This invention describes a secondary bus operating in conjunction with the primary bus, wherein the secondary bus handles the installation or removal of various hardware or peripheral devices. The cost and complexity of a secondary bus however, is prohibitive when applied to a large numbers of networked computers.

Therefore, it remains a heretofore unresolved problem with modular networks, that individual client computers cannot be reset by the host, and that if a reset is issued by the host, it is applied globally to all client computers.

## BRIEF DESCRIPTION OF THE DRAWINGS

**Figure 1** is a generalized drawing of a modular network; and

**Figure 2** is a simplified schematic of an electronic logic circuit, according to this invention.

## DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

The present invention describes a system which enables a host to specifically address one or more of the clients of a modular network, when issuing a reset command.

5 Figure 1 shows an illustration of an exemplary modular network, in which a plurality of modular single-board computers (MSBC's) is connected to an ultra high-speed bus belonging to a host computer. The host contains shared resources such as memory, storage, peripherals and software, which is available to the MSBC's to improve their performance capabilities. The bus serves as the transmission medium between the client

10 computers, and as a conventional parallel bus between the client computers and the host resources.

MSBC cards are initialized per standard automatic configurations protocols, such as Plug and Play, and include unique Media Access Control addresses for network configuration. MSBC cards also contain standard power-on self test initialization routines in

15 non-volatile memory for the initialization of the computer itself. MSBC cards also include circuitry to detect power on, and produce a general reset to all components on the card to simulate initialization procedures, as any independent PC would have.

Figure 2 is a simplified schematic of the logic circuitry embodying this invention. This circuitry is installed on each individual MSBC in the modular network. More

20 specifically, elements **10, 12, 14, 16, 22,** and **28** are on board each of the client MSBC's; the input lines **12, 18, 20, 24** and **26** are available to every MSBC.

An OR gate **10** couples three inputs, any or all of which can initiate a reset to all components of an individual MSBC card. The first input line **12** is the power-on reset line of the host computer. This line is activated in the event that the host experiences a disruption

causing its power to be cycled or its components to be reset. Line **12** is delivered to each of the MSBC's through an contiguous line **12** inputting the signal to the OR gate **10**, causing all components on all cards to be reset.

Line **12** also provides a trigger for enable/disable register **14**, which serves to inhibit further resets from being issued to the MSBC for a specified period of time. When line **12** is energized, register **14** outputs a low signal to AND gate **16**, causing the output of the AND gate to go low. This output is applied to the second of the three input ports of the OR gate **10**, so that no reset is issued as long as enable/disable register is low. The other input to the AND gate is the channel reset line **18**. Therefore, signals from this line are ignored until the enable/disable register is cleared. Therefore, AND gate **16** serves to inhibit the MSBC from responding to a reset command during power cycling of the host.

AND gate **16** can be enabled by line **20**, which can deliver the clear signal to register **14**. When line **20** is activated, command decode electronics **22** interprets the command and determines whether it is directed at this particular MSBC. If the command is indeed addressed appropriately, register **14** is set to a state defined by channel data line **24**. The setting of the enable/disable register **14** allows the AND gate to pass a channel reset command from line **18**. If the reset signal is presented when register **14** is enabled, the command is passed to OR gate **10** and applied to the module. The purpose of the AND gate, operating in conjunction with the enable/disable register, is to avoid multiple or conflicting reset commands from being applied to the MSBC.

The last of the inputs is line **24**, which is an explicit command line from the host to the module, to apply a reset to the components of the MSBC. This signal passes through a similar set of command decode electronics **26**. This circuitry resolves a limitation of

traditional networks as outlined above, in which the host is unable to directly reset a client computer.

AND gate **16** also allows individual MSBC's to reset one or more other MSBC's. This is accomplished through command decode electronics **22**. A client MSBC can issue

5 instructions for specified modules to be reset, by sending the appropriate command to the bus along with the addresses of the targeted MSBC's. Command decode electronics **22** aboard each MSBC interprets the addresses and applies the appropriate signal to enable/disable register **14**. Each module properly addressed by line **20** via the individual command electronics **22** will be reset via the circuitry embodying this invention in Fig. 2. In

10 order to control the issuance of such commands, a specific computer can be configured by hardware or software to have the requisite authority. Techniques to endow such authority, on a limited number of trusted systems, are well known in the art and are not detailed here.

It should be evident to one skilled in the art, by reference to the foregoing embodiment, that many design alternatives exist without departing from the spirit and

15 scope of this invention. For example in the embodiment described above, the modular network system is defined with one modular PC per card, which then plugs into the socket of a host system. This may be advantageous when MSBC cards are added to systems in an existing information infrastructure, or in standard systems for general deployment. As technology improves, multiple MSBC functions may exist on a single card, such that the

20 cards themselves comprise miniature networks. This invention may be scaled commensurately and applied to each subsystem on the card. Furthermore, these multi-PC cards be architected in a hierarchical fashion, to unite large numbers of processors in very large networks and coordinated systems. Again, this invention is applicable to such

complex, hierarchical structures by application of the invention to individual computer

modules or to arbitrarily defined groups of computer modules.

In another embodiment, this invention can be applied to systems that do not form

networks, yet implement multiple independent processing systems on a common bus,

5    network, file interface, or other means of file connectivity.

It should be further understood by those skilled in the art, that various electronic

functions performed by hardware components in the embodiments described, may also be

performed by software, and vice-versa.

In an additional embodiment of the invention, the MSBC's can be used to reset

10    the Host computer.   The MSBC can be set to detect any condition that requires reset of the

host, such as a faulty power supply.    As the MSBC is immune by design to the power on

reset, by the circuitry disclosed, only the host is reset. This function is desirable where a

program running on the MSBC processor, potentially communicating with an external

systems, can be used to revive a hung host machine. The host may be a traditional server

15    or client system and the card may be installed solely for the purposes of effecting an

external reset of the host.  Moreover, the client may reconfigure to appear as the host to

the other clients.

While the invention has been particularly described and illustrated with reference

to a preferred embodiment, it will be understood by those skilled in the art that changes in

20    the description and illustrations may be made with respect to form and detail without

departing from the spirit and scope of the invention. Accordingly, the present invention is to

be considered as encompassing all modifications and variations coming within the scope

defined by the following claims.

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